THE METHOD OF INFECTION OF ACTINOMYCOSIS IN MAN.[1]

WITH A REPORT OF FIVE CASES.

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MEN, as well as domestic animals, are subject to infection with the ray fungus, but the transmission of the disease from the one to the other seems to be of rare occurrence. The published cases of human actinomycosis in their majority do not prove that the patients came in contact with diseased animals, in spite of the fact that the patients mostly came from rural districts. Laboratory research has shown that the fungus is attenuated by passing through the animal body. The microbe has been found thriving on grain, and in actinomycotic ulcers of man as well as of animals sheaths of grain have frequently been found. Many of the patients are reported as habitually using straw for tooth-picks, chewing straw or raw grain, or sleeping on straw, etc. From these and similar observations one has come to the conclusion that man, as a rule, does not contract actinomycosis from domestic animals, but from grain and grain products.

I intend to speak referring to personal observation about the source of human actinomycosis, the place of entry, and the conditions of the organs necessary or favorable to the infection.

Two of the patients, both strong and otherwise healthy young men previous to their illness, were occupied in unloading a stranded wheat steamer in Lake Erie, and frequently chewed the raw grain. I saw one of them in consultation with the attending physician. A hard, diffuse swelling presented itself at the neck below the angle of the mandible. At a previous operation no pus had been found, and at the second one,

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done in my presence, not more than one tablespoonful was evacuated. I took a specimen of this pus and found it to contain the fungus. The second patient was exhibited by Dr. Sanderson, of Windsor, Canada, at the Detroit Medical and Library Association, without having been operated upon, and lacking a microscopical proof. The symptoms were exactly the same. From analogy with his comrade the diagnosis seems to be justified. No further comment on the source and method of infection is necessary in these two instances.

Of my other three patients, two lived on farms near, and one in the suburbs of, Detroit, Michigan, with farms in the immediate neighborhood. In spite of repeated inquiries, nothing could be learned about diseased animals and chewing of raw grain, etc. When patients have come in contact with animals suffering from actinomycosis, they hardly can fail to notice it. It seems sure, therefore, that these patients must have contracted the disease from grain, or at least from something outside the animal kingdom. As chewing of raw grain was denied, the question arises whether grain products, after having been prepared in the kitchen, may still carry the virulent fungus. From experiments made to learn the effect of wet and dry heat on the fungus, it seems to be certain that the cooking and baking processes will destroy it. Under such circumstances, one is inclined to accept the lung as the place of entry in the above cases. Chances to inhale the microbe are abundant on farms, especially during the threshing season. As will be shown later, this mode of infection finds support in only one of the cases. Even here it is not the only possibility, and contaminated food would offer just as good, or better, an explanation. It seems to me that only the dust fallen on fruit, lettuce, and similar products or into open wells remains. In the literature, I found nothing in support of such a possibility. It may be a suitable object for bacteriological investigation, and perhaps another reason to cover open wells on farms.

After proving that the alimentary canal need not be excluded as the primary seat of the disease in our cases, let us

see in which direction the special circumstances point. Two of the patients, both females, never had any pulmonary symptoms whatever. Actinomycotic abscesses were opened far distant from the lungs at the lower abdomen on the left side, and spread from here to the navel in one and the gluteal region in the other patient. In one case I did not obtain the permission to attempt a radical operation, in the other the process seemed too far advanced to make such a proposition justifiable. The original point of infection, therefore, was not laid open. The question, what may be found after opening the abdominal cavity in cases with actinomycotic abscesses at the region described above, is of theoretical as well as practical interest. According to the history of the cases, the disease was doubtless of internal origin. The two organs to be considered are the uterine appendices and an intestinal loop. As primary actinomycosis of the former is extremely rare, and perhaps not yet diagnosed, beyond doubt only the latter remains. In both cases, therefore, the infection has taken place through the alimentary canal. The question, which part of the tract was involved, will be discussed later.

An objection to this, based on experimental research, may be made here, and has to be disposed of first. The disease promptly develops if the fungus is brought directly into the animal tissues, and always fails to do so after simply feeding virulent cultures. It seems, therefore, that the carrier of the microbe must be able to penetrate the surface of the gut, as it easily may happen in the mouth by chewing straw, etc. But how can this be perfected by the substances pointed out above, as the only source of infection in our cases,—lettuce, well water, etc.? It may be that some points in the histories of my patients lead us in the right direction. One of these patients was recovering from typhoid fever when the actinomycotic process came to the surface. The attending physician was most positive in his diagnosis, and stuck to it after later developments. The fever, the stool, and the roseola had been typical. I operated under the impression that a perforated typhoid ulcer had caused an abscess, and was very

much surprised to discover the ray fungus in the scanty, thick pus. The inoculation of a typhoid ulcer from well water would be a very satisfactory explanation. Consulting the literature, I could not find anything very conclusive in this respect. One case is reported by Dr. Lange in the ANNALS OF SURGERY, 1896, p. 371, with typhoid-like symptoms preceding the formation of an abdominal actinomycotic abscess. In other publications, no hint is given that the usual symptoms of intestinal actinomycosis—fever, diarrhœa, and blood in the stool—were of a character to suggest typhoid fever. Special attention being given to this point in the future, some true cases of typhoid may be diagnosed where it was not formerly suspected. That such a relation between the two diseases is of frequent occurrence cannot be assumed. It hardly would have escaped detection for such a long time, as actinomycosis is known already. It may be that in my case the occurrence of both diseases is simply a coincidence. The question cannot be decided definitely without post-mortem findings, the Widal test, or at a radical operation.

As mentioned before, one of the reported cases conveys the impression as being one of primary pulmonary actinomycosis. The patient, who never had any pulmonary symptoms previously, was suddenly seized with severe coughing spells. There was hardly any sputum raised, but a very offensive odor emanated from the lung with each attack. An aspirator inserted between the lower ribs of the right side withdrew offensive pus. At the operation, I found an abscess distinctly situated in lung tissue of about a hen's-egg size and actinomycotic in character, as microscopical examination proved. The patient suffered from diabetes at the same time, and died in coma a few days later. Additional to the lung abscess, two others were found at the post-mortem,—one in the liver, the other surrounding the upper half of the right kidney, all three in continuous communication through narrow channels. They contained very little pus, and did not produce any enlargement of the organ which could have led to their discovery before or at the operation. No ulcers, scars,

or strictures were found in the alimentary canal. The appendix was freely movable, contained two small semi-solid particles of brownish color, and its mucous lining seemed to be normal. A coil next to it was folded upon itself by an adhesion. With this additional knowledge, let us reconsider the diagnosis of primary pulmonary actinomycosis. As no actinomycotic process was found in the intestinal canal, the lung was the only one of the affected organs communicating directly with the outside. A small particle having virulent germs could produce the necessary lesion in the tender lining of the smallest air passages. Nevertheless, I cannot accept the original diagnosis as an indisputable one. The reasons are as follows:

(1) According to other writers, primary intestinal actinomycosis may heal spontaneously, and the secondary process continue to spread. (2) Primary intestinal actinomycosis in by far the majority of cases is situated at the appendix or colon. (3) My patient passed through a typical attack of appendicitis, which left slight evidence revealed at the post-mortem. (4) An abscess of the liver, secondary to an appendiceal process and located between the lung and kidney abscesses, could perforate more easily into both of these organs than a primary lung abscess could do, situated at one end of the row of abscesses.

At the time of the post-mortem, the possibility of primary abdominal actinomycosis did not occur to me, and I may have lost here a very valuable link in the chain of evidence. A microscopical examination of the concrements in the appendix, which I failed to make, could have shown the presence of the fungus, and thereby render the arguments for primary appendiceal actinomycosis and secondary liver abscess almost indisputable. Under the circumstances, we must content ourselves by admitting both ways of infection, and aiding through our loss future observers.

I return now to the intestinal ulcers as places where the ray fungus may enter the system. There are no cases, or very few, reported of ulcers of the stomach, tubercular, syphi-

litic, or carcinomatous ulcers of the small and large intestines becoming actinomycotic. It seems, therefore, that these large, open, chronic lesions are not the ground favorable to the growth of the microbe. The fact that actinomycosis of the lung mostly occurs at the lower lobe, contrary to tuberculosis, does not necessarily mean antagonism between these two diseases. Inhaled particles laden with the germ may rather fall into the lower than the upper part of the lung. But the non-occurrence or rarity of actinomycosis on the open intestinal ulcers described above rather indicates that fresh accidental lesions are needed by the microbe, as sheaths of grain and similar bodies may produce them. The large intestine is certainly more favorable for such an occurrence than the small intestine. Sharp bodies protruding from solid scybalæ are pressed against the mucous lining of the large intestine. As this organ, therefore, is exposed evenly over its whole course, there should be no predilection of the disease for any particular part of it. But such is not the case. Actinomycosis is most frequently found at the cæcum or the appendix and at the rectum. Other writers have tried to explain this by the sluggishness of the gut, which is most pronounced at the two mentioned localities. If we combine the two points, it results in a continued contact of infected material with the wounded surface. A more acceptable explanation can hardly be given with our present knowledge.

We are now perhaps in a position to locate more definitely the origin of the disease in the two female patients with abscesses at the lower left abdomen. The rectum being a place of predilection, it is almost certain that the fungus found there its place of entry. In the case of the patient with typhoid fever, we must certainly leave some room for doubt. At the time I operated on these patients, the primary process was either healed or too high up in the rectum to be reached by the exploring finger. Such considerations are certainly important regarding operative interference for abscesses at the lower left abdomen, but cannot be dwelt upon in a paper on the etiology of human actinomycosis.

It is hardly necessary to mention that typhoid fever and diabetes may be of etiological importance, in so far as they lower the resisting power of the tissues against the entrance and growth of the microbe. In both patients—the one with typhoid and the one with diabetes—the disease took a rapid course.

In looking over again the arguments furnished by our cases and collected from the literature, we find the wounded surface very acceptable as a necessary predisposing cause of actinomycosis. But to fully recognize the details of the process more proof is needed. This may be obtained artificially in the laboratory, and more conclusively in certain geographic localities by observing the method of nature. First, in Russia, where, contrary to other countries, actinomycosis of the skin is the most frequent form of the disease in man. Second, at those places where cattle grazing on salt marshes frequently flooded by the sea are reported to be especially exposed to actinomycosis. In both instances it cannot be so very difficult to ascertain whether some injury occurred previous to the development of the disease, and whether the infection was done by the injuring article itself, or by secondarily introducing infected material. This latter point is especially important in regard to intestinal actinomycosis, as we have pointed out above. As far as human beings are concerned, an anamnestic inquiry has to bring out the desired facts. In the case of cattle, it would be necessary to make a thorough and frequent examination of the animals for wounds in the mouth. Shells and sand left by the receding water on the grass may easily produce abrasions and cuts. The infection must not necessarily take place at the marshes. If the sores are there, the microbe-bearing particles may enter later, when the animals are fed in the stable on grain products. Such investigation may also lead to preventive measures for both man and animal.

In conclusion, I enumerate the facts or disputed points which are made prominent by the cases of actinomycosis, forming the basis of my paper.

(1) The diagnosis of "primary pulmonary actinomycosis," even in the absence of all abdominal symptoms, must remain doubtful without a post-mortem examination.

(2) In abdominal as well as in pulmonary actinomycosis, the patient should be closely questioned regarding any previous more or less indistinct symptoms of appendicitis and sores at the anus.

(3) Fæcal concrements found in the appendix in cases of actinomycosis should be microscopically examined.

(4) In actinomycosis following typhoid-like symptoms, a Widal test should be made.

(5) At the post-mortem, special attention must be paid to intestinal scars, which may easily avoid detection.

(6) Experiments and clinical observation indicate that the fungus cannot enter the human or animal body without a wounded surface.

(7) Must the wounded body also be the carrier of the infectious material, or can infection take place secondarily through a granulating accidental wound or the chronic ulcers mentioned above?

(8) Human actinomycosis of the skin or actinomycosis of the jaw in pasturing cattle may offer a suitable object for investigation in regard to point No. 7.